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TECHNICAL REPORT 91-1

LONGITUDINAL JOINT CONSTRUCTION IN ASPHALT CONCRETE PAVEMENTS

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LONGITUDINAL JOINT CONSTRUCTION
IN
ASPHALT CONCRETE PAVEMENTS

Prepared by

David W. Bernard, P.E.
Senior Civil Engineer

and

Mark T. Grainer
Junior Engineer

January, 1991

MATERIALS BUREAU
WAYNE J. BRULE, DIRECTOR

NEW YORK STATE DEPARTMENT OF TRANSPORTATION
1220 WASHINGTON AVENUE, ALBANY, NY 12232

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LONGITUDINAL JOINT CONSTRUCTION

IN ASPHALT PAVEMENTS

Introduction

The New York State Department of Transportation initiated research into the construction of longitudinal joints in asphalt pavements during the 1990 construction season. The purpose of this research effort was to determine if our current specification governing longitudinal joint construction is producing acceptable results. In addition, this research sought to identify new techniques which may improve our current jointing procedures.

Current NYS Longitudinal Joint Procedure

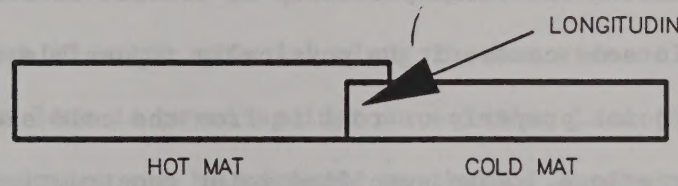
When asphalt pavements are reconstructed, maintaining traffic usually limits asphalt paving to single lane operations. As additional lanes are paved next to existing lanes, longitudinal joints are created between them.

New York State Department of Transportation currently specifies the construction of longitudinal joints in asphalt pavements by overlapping the adjoining lane (or cold mat). This procedure is shown in detail in Figure 1. Overlapping the cold mat by 2-3 inches leaves additional hot asphalt along the joint area. The additional material allows the paver to occasionally drift slightly away from the joint without affecting it. The additional hot asphalt is raked manually, forming a mound along the hot side of the longitudinal joint (see Figure 1.2). The mound of extra material is compacted (or "pinched") into the joint by maintaining the roller on the cold mat and overlapping the hot joint by approximately 6" (Figure 1.3). Once the longitudinal joint is rolled, the remainder of the hot mat is compacted.

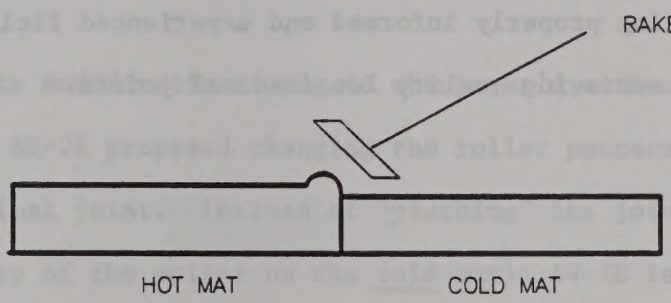
FIGURE 1

CONSTRUCTION OF NYSDOT LONGITUDINAL JOINT

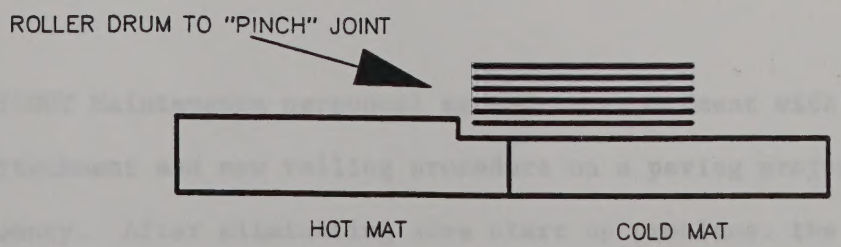
(CROSS SECTIONAL PERSPECTIVE)



1. OVERLAPPING OF HOT ASPHALT MATERIAL ALONG LONGITUDINAL JOINT



2. RAKING EXTRA MATERIAL INTO MOUND ALONG LONGITUDINAL JOINT



3. ROLLING OF LONGITUDINAL JOINT FROM COLD MAT

Field Problems Affecting Longitudinal Joint Construction

When the current longitudinal joint specifications are followed durable joints are generally produced. However, field problems can adversely affect the construction of quality joints. Maintaining traffic during paving operations has one of the biggest impacts on longitudinal joint quality because of the close proximity of traffic to construction personnel. In some cases, it is physically impossible to rake the longitudinal joint properly or roll it from the cold side because of traffic restrictions. When specified joint construction procedures are not followed, poor pavement densities result along the joint. Poor joint densities lead to early deterioration and reduce the service life of the pavement. Having properly informed and experienced field personnel is a key factor in achieving quality longitudinal joints.

Alternate Method To Construct Longitudinal Joints

A new method of constructing longitudinal joints in asphalt pavements was proposed during the 1990 construction season. The new method involves a standard paver screed modified by installing a proprietary screed attachment to one end. The one foot wide screed attachment is designed with an inverted "V" notch in the bottom plate. This notch leaves a specific amount of extra material along the hot side of the longitudinal joint as a new lane is paved against an existing lane (See Figure 2.1). The notch's function can be compared to that of a raker mounding overlapped asphalt concrete. The screed attachment was developed by Alternate Ways to Rebuild Roads (AW-2R).

In addition to modifications made to the paver's screed (screed attachment), AW-2R proposed changing the roller pattern used to compact the longitudinal joint. Instead of "pinching" the joint from the cold side (majority of the roller on the cold mat), AW-2R is recommending rolling the joint with a majority of the roller on the hot mat (Figure 2.2). The idea behind this change is to horizontally squeeze the hot mat against the cold mat while confining the mix under the weight of the roller.

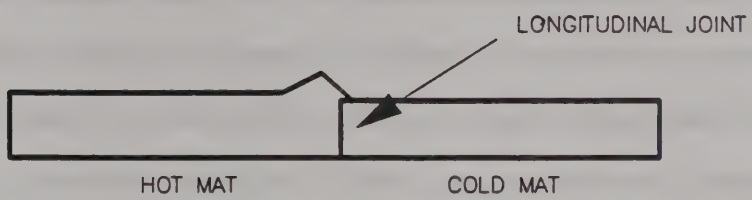
NYSDOT Maintenance personnel agreed to experiment with the AW-2R screed attachment and new rolling procedure on a paving project in Greene County. After eliminating some start up problems, the paving crew was pleased to replace a raker with the screed attachment.

However, a major problem was encountered using the screed attachment. By removing the overlapped material which is currently specified, the horizontal alignment of the equipment becomes critical. The paver must exactly match the previously paved mat which generally is not a straight line. Any horizontal drift of the paver can cause too much or too little asphalt along the longitudinal joint. This creates either a hump or void along the joint.

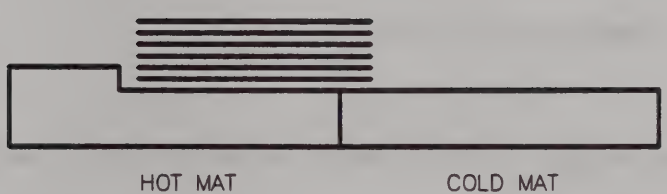
FIGURE 2

LONGITUDINAL JOINT CONSTRUCTION AW-2R SCREED ATTACHMENT

(CROSS SECTIONAL PERSPECTIVE)



1. NOTCH OF SCREED ATTACHMENT LEAVES EXTRA MATERIAL AT JOINT.



2. ROLLING LONGITUDINAL JOINT ON HOT MAT. EXTRA MATERIAL IS SQUEEZED INTO JOINT.

Evaluation of Alternate Jointing Method

Longitudinal joint research attempted to compare our currently specified approach with a new method proposed by AW-2R. New York's current method involves raking overlapped asphalt concrete into a mound and compacting the longitudinal joint with a majority of the roller on the cold mat (Conventional Method). AW-2R has proposed using a screed attachment to leave extra asphalt concrete along the joint similar to raking. The joint is compacted in this case, with the roller predominantly on the hot mat (AW-2R Method).

Both jointing methods described above were compared directly on a two lane section of Rte. 145, near East Durham, NY. Greene County Maintenance personnel completed the 1 1/2" overlay using Type 6F dense top bituminous concrete. The overlay was compacted using a 10 Ton static roller at a temperature of 250°F.

Several days paving were completed using the AW-2R method for constructing the longitudinal joint. The last day of paving (approx. one mile) changed longitudinal joint construction to conventional methods involving raking and rolling from the cold side.

Test Pattern (See Figure 3 and 4)

Two test sections were established along the longitudinal joint. The two different jointing methods evaluated were represented by one test section each. Each 1/10 mile test section consisted of a nuclear gauge test pattern positioned immediately adjacent to both sides of the joint. Pavement cores were also taken in a few locations that were tested by the nuclear gauge. The pavement cores will be used to correlate the nuclear gauge results to actual bulk densities. The Troxler 4640 Thin Lift nuclear gauge recorded density by averaging four readings at each point. While measuring each point, the gauge was rotated 90° for each 60 second measurement.

TEST RESULTS

The density of the asphalt overlay was determined by both destructive and non-destructive testing. Destructive testing involved six inch pavement cores tested for bulk density. The top layer, approximately 1 1/2", was removed from the cores to evaluate only the overlay density. The pattern of coring is shown in Figures 3 & 4. A total of 12 cores were taken to compare the two different joint construction methods. In each area, two cores were taken on the longitudinal joint and four others were positioned to duplicate nuclear gauge test points.

The cores taken along the longitudinal joint in both areas were compared. The joint constructed using the AW-2R screed attachment (and rolling from hot mat) showed 6 lb/ft^3 higher density compared to conventional methods of joint construction (raking excess and rolling from cold side). It appeared the higher density resulted from changing the roller pattern rather than differences in how extra asphalt was established along the joint.

In areas where pavement cores and nuclear gauge measurements were taken together, the magnitude of nuclear gauge reading varied significantly from core densities. The gauge was capable of identifying pavement areas of high verse low density, however the actual density values were questionable. Therefore, more significance was assigned to core densities than to nuclear gauge readings.

In general, the results from the nuclear gauge testing were difficult to interpret. In all cases, the gauge measurements were lower than core densities. In the eight areas where both tests were performed, the gauge readings varied from 1-6 lb/ft^3 from core results. In one case, when four nuclear gauge readings were taken at one point by rotating the instrument, the density readings varied by as much as 13 lbs/Ft^3. Lastly, one pattern did seem to be established for both testing procedures. Regardless of which procedure was used to construct the longitudinal joint, slightly lower densities were achieved at the joint than in the surrounding pavement.

CONCLUSIONS

1) It is difficult to produce adequate joint density along longitudinal joints when constructing a hot asphalt mat adjoining a cold mat.

2. During some rehabilitation (overlay) projects, specified joint procedures are not followed because of traffic hazzards adjacent to joint construction. Unfortunately, the need to maintain traffic and provide for worker safety during joint construction are conflicting issues.

3) If raking or overlapping longitudinal joints are omitted, or raking is done incorrectly, poor joint density is the result.

4) When the currently specified longitudinal joint procedures are enforced, adequate joint densities are produced.

5) When constructing longitudinal joints in asphalt pavements, it is important to leave extra asphalt concrete along the joint (by raking into a mound or other methods). The extra material is compacted into the hot side of the joint improving density.

6) When constructing longitudinal joints in asphalt pavements, it is important to overlap the existing lane during placement of the new lane. The overlapping provides extra material along the joint and allows for side to side drift of the paver.

7) When compacting longitudinal joints, the specification requires positioning the roller with a majority of the drum riding on the cold mat. Compacting the joint statically with the roller predominately on the hot mat produced higher joint densities compared to rolling from the cold side (142 lbs/ft^3 (Hot) vs 136 lbs/ft^3 (Cold)).

8) Regardless of how extra asphalt concrete is deposited along the joint, the method of rolling had a larger impact on improving density than the method of mounding extra material (raking vs AW-2R screed attachment).

9) The AW-2R screed attachment is capable of forming extra material along the longitudinal joint similar to raking overlapped material.

10) The side to side alignment of the paver becomes critical when using the AW-2R screed attachment because overlapping is eliminated. Alignment problems can cause too much or too little asphalt to be deposited along the joint and may create more problems than the use of the screed attachment solves.

11) The results of this longitudinal joint study suggests Maintenance may change the way they roll longitudinal joints. Conclusions only apply to statically rolled joints and pavement. They do not apply to projects which use vibratory rollers.

12) The Troxler 4640 Thin Lift nuclear gauge provides quick density results in the back scatter mode. However, the magnitude of the results varied from pavement core densities. Therefore, the nuclear gauge can be used as a comparison tool between points, but not as a measure of an absolute density value.

CONTINUING LONGITUDINAL JOINT RESEARCH

1) When placing a hot asphalt mat against a cold mat, tack coating the longitudinal joint should be considered to increase bond.

2) The New Jersey Department of Transportation uses a wedge type longitudinal joint in their asphalt pavement construction. New York should consider trying this system experimentally to determine its effectiveness and constructability. Particular attention should focus on the infrared heating of the joint. Past experience has shown problems with the infrared system over-heating the asphalt when the paver stops.

3) Longitudinal joint construction literature and specifications should be obtained from other States. These procedures should be evaluated, and if thought significant, tried on a paving project.

4) Further research should be initiated into the use of the AW-2R screed attachment with vibratory rollers. Present data only applies to the screed attachment used with static rollers.

APPENDICES

401-3.13 JOINTS.

B. Longitudinal. Placement of the surface course shall be carefully planned to assure that the longitudinal joints in the surface course will correspond with edges of proposed traffic lanes. Other joint arrangements will require approval of the Engineer. When traffic is maintained on the roadway during paving operations, the mixture shall be laid such that no more than 100 feet of the pavement edge will be exposed at the end of the working day. The Engineer may permit an exposed edge of this type in excess of 100 feet providing that the edge is adequately protected against damage by vehicles and equipment.

When paving adjoining lanes, the asphalt concrete shall be laid such that it uniformly overlaps the adjacent lane 2 to 3 inches. The thickness of the overlap material shall be approximately 1/4 the compacted thickness of the course, so as to result in a smooth and well compacted joint after rolling. The overlapped material shall be broomed or raked back onto the adjacent hot lane so that the roller operator can crowd the small excess into the hot side of the joint. If the overlap is excessive, the excess material shall be trimmed off so that the material along the joint is uniform. The coarse particles of aggregate in the overlap material shall be removed and wasted if deemed necessary by the Engineer.

Compaction of the longitudinal joint shall be done in static mode and as close to the paver as possible. The first pass shall be made with the roller travelling toward the paver and operating on the previously placed lane with 6 to 8 inches of the roller drum protruding onto the hot mat. The roller shall apply a second pass to the joint as it travels back away from the paver. All turning movements of the roller shall be done on previously compacted material. After applying two roller passes on the longitudinal joint, the roller shall then proceed to the low side of the lane and compact as described in §401-3.12 Compaction. If a single drum vibratory roller with pneumatic drive wheels is used, the roller shall be in the static mode and the same procedure shall be followed except that the roller shall be aligned on the joint so that the pneumatic drive wheels travel on the joint."

FIGURE 3

RESULTS DIAGRAM
AW-2R SCREED ATTACHMENT

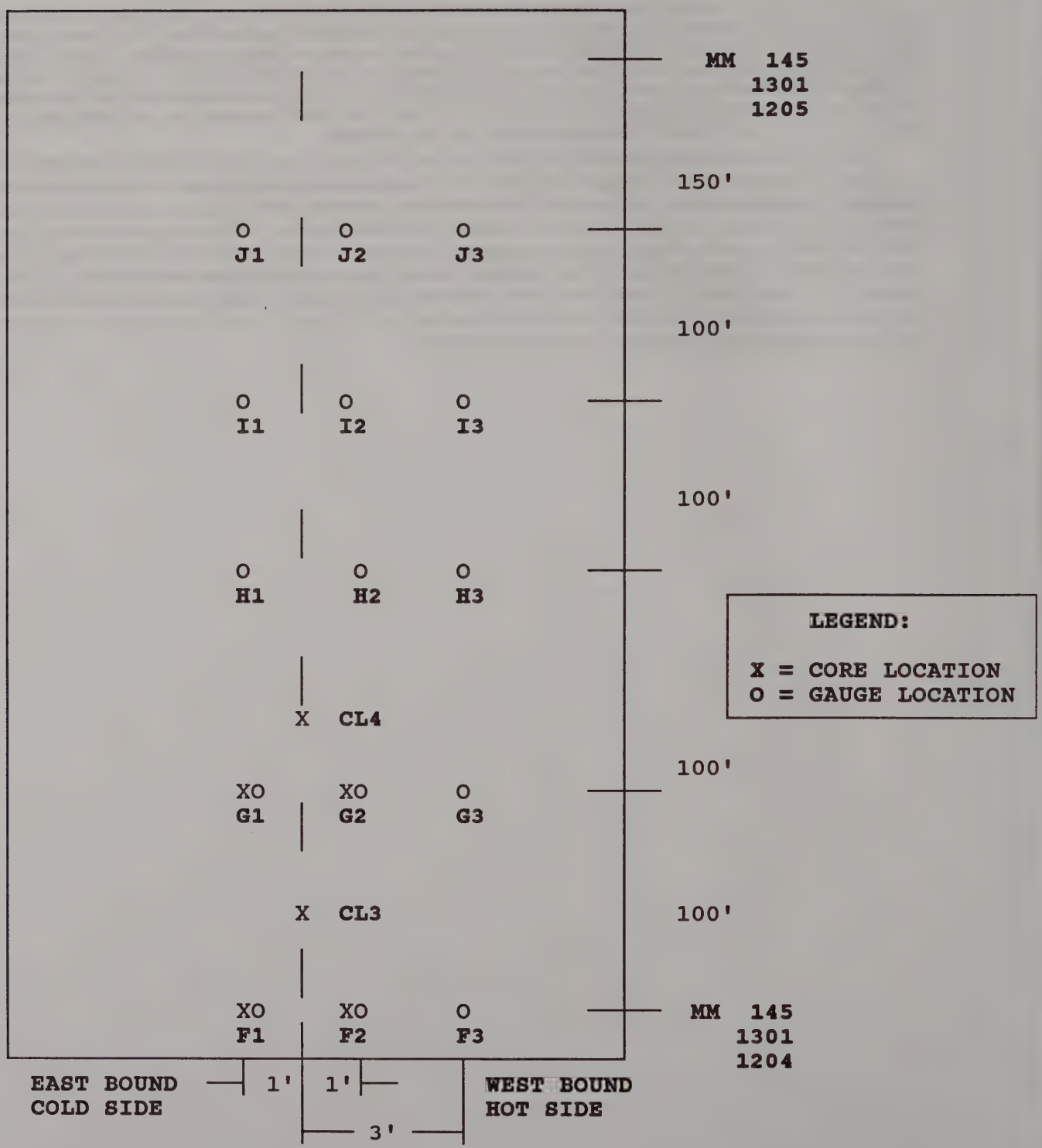
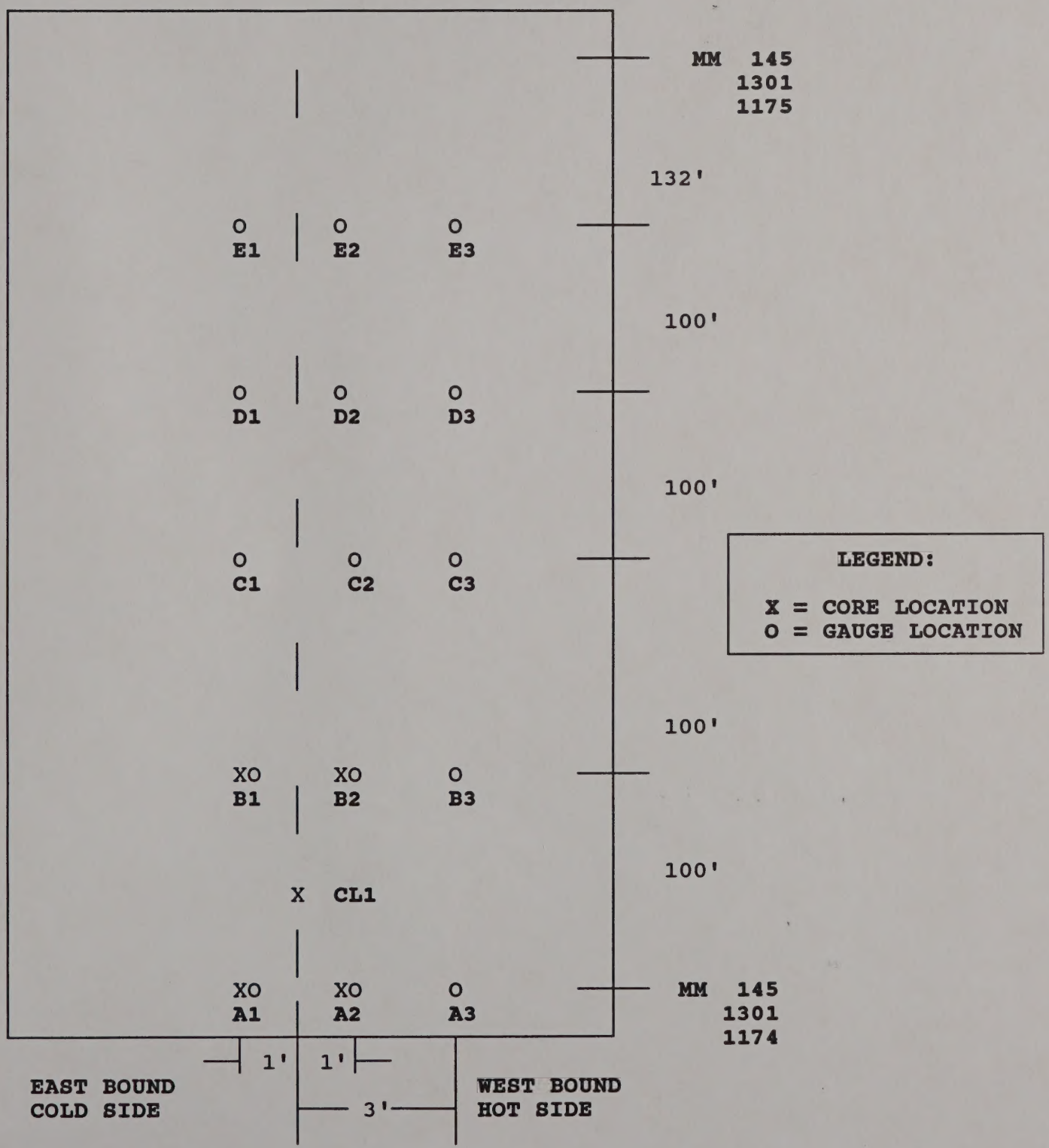


FIGURE 4

RESULTS DIAGRAM
RAKED SECTION



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